14th ICBEN 2023 18 - 22 JUNE BELGRADE

14th ICBEN Congress on Noise as a Public Health Problem

Pilot of Longitudinal Study to evaluate the Quality of Life and Health Effects of the Heathrow Noise Insulation Schemes

Nicole Porter[1], Charlotte Clark[2], Robin Monaghan[1], Richard Norman[3]

[1] Anderson Acoustics Ltd, 3, Trafalgar Mews, 15-16 Trafalgar St, Brighton, BN1 4EZ, UK
[2] St George's, University of London, London, Cranmer Terrace, London SW17 0RE
[3] Heathrow Airport Ltd, The Compass Centre, Nelson Road, Hounslow, Middlesex, TW6 2GW, UK

Corresponding author's e-mail address: nicolep@andersonacoustics.co.uk

ABSTRACT

Heathrow Airport Ltd has been working with other airports, in partnership with ACI-Europe, to consider a research roadmap for aviation noise with the overall outcome of the co-ordinated research programme agreed as working towards better understanding of airports' impact on Quality of Life (QoL), with the need to better understand the value (in terms of noise reduction and health outcomes) and effectiveness of the interventions airports make. ICAO's Balanced Approach and EU 598 requires the identification of noise-related measures that achieve maximum environmental benefit - requiring cost effectiveness assessments. There is limited empirical evidence available to support the effectiveness of Noise Insulation Schemes (NIS) on health or QoL, nor have studies evaluated the economic cost-benefits for health of such schemes. Against this background, Heathrow airport are commissioning an independent longitudinal study to evaluate the QoL and health effects of the Heathrow NIS. Starting in 2023, the pilot develops and refines the methodology and questionnaires, with the main study to run from 2024. It involves collecting information on noise exposure within the home and individual-level information about a range of QoL, wellbeing and health outcomes. The longer-term aspiration is to quantify the effect of insulation on changes in health and quality of life and to examine effect modification by demographics and attitudes. This paper sets the scene and gives an update on the pilot work. Interim and final reports are likely be prepared in 2024/5 and 2026/7, with an intention to publish updates at conferences throughout the work programme.

Keywords: Noise Insulation, Intervention, Quality of Life, Airport, Aviation,

INTRODUCTION

Environmental noise is accepted as a public health issue and has significant impacts on physical health, mental health, and wellbeing[1]. In terms of environmental noise, the past two decades have seen an increase in evidence linking exposure to annoyance[2,3], sleep disturbance[4], cardiometabolic health[5], children's learning[6,7], and mental health[6,8,9].

Environmental noise can influence health, as it can trigger biological responses in an individual, such as increasing stress hormone levels and influencing risk factors for poorer cardiometabolic health such as blood pressure, blood sugar and blood fats[10]. If these biological responses are triggered over a long period, they can lead to poorer mental health and diseases such as diabetes, heart attacks and strokes. These biological responses can also be triggered by annoyance and sleep disturbance associated with environmental noise exposure[4].

It follows that a reduction in noise exposure, whether via source, path, or infrastructure interventions[11], should reduce impacts on health outcomes. However, very few studies attempt to quantify the effects of a change in exposure on quality of life or health outcomes, and few quantify the effectiveness or impact of noise insulation schemes on these outcomes, despite this being one of the more common noise interventions undertaken.

A systematic review carried out to inform the World Health Organization's Environmental Noise Guidelines for the European Region 2018[12] included a review of intervention studies published between 1980 and 2014, quantifying the strength of the evidence regarding interventions for environmental noise effects on health. The review found that there were few studies of interventions, and particularly studies of aircraft noise exposure, or health outcomes other than annoyance. There were few studies of noise insulation, per se and the review noted the lack of before and after study designs. In fact, many studies only assessed health after the intervention was in place.

Within this context, Heathrow Airport Ltd has been working with other airports, in partnership with ACI-Europe, to consider a research roadmap for aviation noise with the overall outcome of the co-ordinated research programme agreed as working towards better understanding of airports' impact on Quality of Life (QoL), with the need to better understand the value (in terms of noise reduction and health outcomes) and effectiveness of the interventions airports make[13] (see figure 1). ICAO's Balanced Approach and EU 598[14] requires the identification of noise-related measures that achieve maximum environmental benefit - requiring cost effectiveness assessments. It is becoming increasing important to establish the effect of noise insulation schemes on the health, sleep and quality of life of the recipients. Planning processes are increasingly under pressure to indicate how noise insulation, typically the intervention relied upon to 'avoid and mitigate and minimise the effects of noise on health and quality of life', influences health, sleep and quality of life.

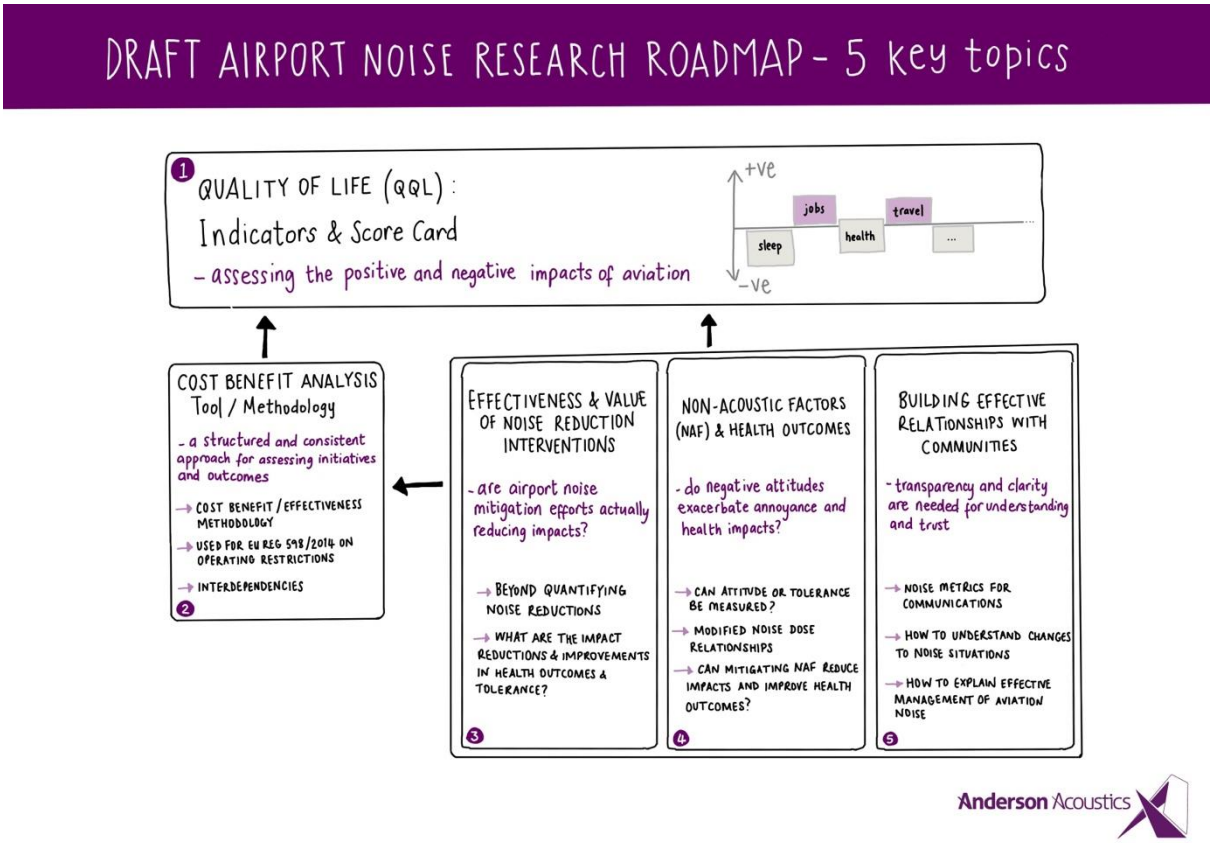

Figure 1: Research Roadmap for Aviation Noise

Taken together, there is limited empirical evidence available to support the effectiveness of Noise Insulation Schemes (NIS) on health or QoL, nor have studies evaluated the economic cost-benefits for health of such schemes. Against this background, Heathrow Airport are commissioning an independent longitudinal study to evaluate the QoL and health effects of the Heathrow NIS.

AIM OF THE PILOT STUDY

The overall aim of the main study is to carry out a robust assessment of the effect of a NIS on the health, quality of life and self-reported sleep. It will also explore how the impact of the NIS is influenced by the processes of engaging with the scheme/operators and demographic factors (age; attitudes to airport). Starting in 2023, the pilot aims to develop and refine the methodology and questionnaires.

METHODOLOGY

The main study will be a before-and-after study of residents eligible for Heathrow's NIS. It will involve:

- Collecting information on noise exposure within the home;

- Collecting individual-level information via a survey about a range of quality of life, wellbeing and health outcomes.

The survey will use standardised measures of quality of life, wellbeing and health that would be expected to show a change over the time-period of the intervention; collect detailed information about the type of noise insulation installed; and evaluate the processes involved in engaging with the scheme/operators. Analyses will assess change in annoyance, quality of life, wellbeing, and self-reported sleep disturbance, and explore effect modification of response by demographics, and reported experiences with the scheme/operators.

The pilot will test the methods and protocols on a small sample of 50 participants. It will also examine recruitment procedures and response rates and data collection rates for the survey. The research team will conduct short-term noise monitoring inside and outside the participant's residence. This will be used to quantify the change in noise exposure after installation of the insulation, which can then later be related to change in health, quality of life and wellbeing. The pilot study will inform decision making for the main study, which will take place over a 2-year period.

The pilot runs from March 2023 a small sample of 50 participants. Following refinement of the methodology, the main study will collect data on a sample of 160 participants.

DATA COLLECTION

The study will collect the following data from participants at each phase (before, within 3 months of installation and within 12 months of installation);

- Sound levels inside and outside the home (see next section).
- Wellbeing, quality of life, annoyance, and subjective sleep quality – Self-report paper questionnaire - this has been developed for the pilot.
- Attitudes – self report paper questionnaire.
- Ratings of NIS processes and instalment- self report paper questionnaire.

ACOUSTIC MEASUREMENTS

Measurement of Sound reduction of glazing - Using Loudspeaker

Simultaneous internal and external noise measurements will be conducted in general accordance with BS EN ISO 16283-3:2016 Section 9 'Outdoor measurements using a loudspeaker as a sound source'[15]. A loudspeaker will be used to generate a noise signal outside of the façade being tested whilst noise measurements are taken internally (see figure 2).

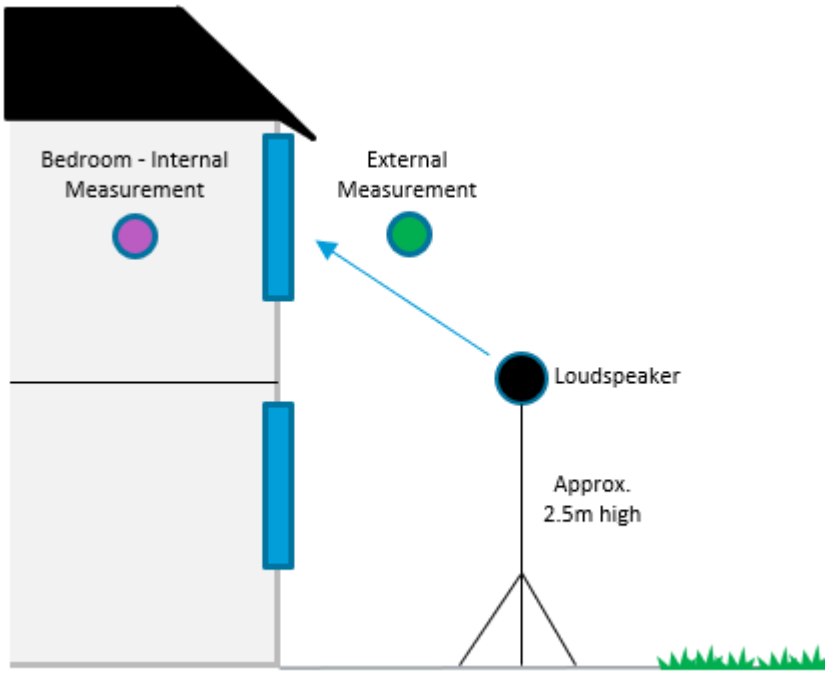

Figure 2: Illustration of sound reduction measurement using loudspeaker

Measurement of Sound reduction of glazing - Using ambient noise conditions

Noise levels will also be taken simultaneously externally and internally using the ambient noise levels inclusive of aircraft movements to obtain additional level difference data of the facade.

Ambient noise measurements - External measurements

Where reasonably possible, external monitoring will be undertaken in compliance with British Standard BS 7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures'[16], with microphones positioned at a height of 1.2 m above ground level and at least 3.5 metres from any acoustically reflective surfaces.

Ambient noise measurements - Internal measurements

Where reasonably possible, internal monitoring will be undertaken in compliance with British Standard BS 7445-1:2003 'Description and measurement of environmental noise[16]. Guide to quantities and procedures' section 5.2.3 'Measurements inside buildings'. If not otherwise specified, the preferred measurement positions are 1 m to 2 m from the facade and 1.2 m to 1.5 m above each floor level of interest.

NEXT STEPS

The pilot work has commenced, and progress will be reported at the time of the

presentation. Interim and final reports are likely be prepared in 2024/5 and 2026/7, with an intention to publish updates at conferences throughout the work programme.

REFERENCES

1. European Environment Agency. Environmental Noise in Europe 2020. Luxembourg: Publications of the European Union, 2020.
2. Guski, R., Schreckenberg, D., & Schuemer, R. (2017). WHO Environmental Noise Guidelines for the European Region: A systematic review on environmental noise and annoyance. International Journal of Environmental Research and Public Health, 14, 1539, 2017.
3. Janssen, Vos, van Kempen, Breugelmans, & Miedema, 2011, Trends in aircraft noise annoyance: The role of study and sample characteristics, Acoust Soc Am 129, 1953–1962, 2011
4. Basner, M., & McGuire, S. (2018). WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep. International Journal of Environmental Research and Public Health, 15(3), 519.
5. van Kempen E, Casas M, Pershagen G, Foraster M. WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Cardiovascular and Metabolic Effects: A Summary. Int J Environ Res Public Health 2018; 15(2).
6. Clark, C., et al. (2021). A meta-analysis of the association of aircraft noise at school on children's reading comprehension and psychological health for use in Health Impact Assessment. J Environ Psychol, 101646.
7. Clark, C., & Paunović, K. (2018a). WHO Environmental Noise Guidelines for the European Region: A systematic review on environmental noise and cognition. Int J Environ Res Public Health, 15, 285.
8. Clark, C., & Paunović, K. (2018b). WHO Environmental Noise Guidelines for the European Region: Systematic review of the evidence on the effects of environmental noise on quality of life, wellbeing and mental health. Int J Environ Res Public Health, 15(11), 2400.
9. Hegewald, J., et al. (2020). Traffic Noise and Mental Health: A Systematic Review and Meta- Analysis. Int J Environ Res Public Health, 17(17).
10. Münzel, T., et al. (2021). Transportation noise pollution & cardiovascular disease. Nat Rev Cardiol.
11. Brown. A.L. & van Kamp, I. WHO Environmental Noise Guidelines for the European Region: A Systematic Review of Transport Noise Interventions and Their Impacts on Health**.** Int J Environ Res Public Health, 14(8), 873, 2017.
12. World Health Organization. (2018). The World Health Organization Guidelines for Environmental Noise Exposure for the European Region. In. Copenhagen: Denmark: World Health Organization Europe.
13. Porter. N, Norman. R ; Oh, X. InterNoise 2018, Chicago, IL, pages 2984 - 3995, pp. 3415-3418(4), 2018.

14. Regulation (EU) No 598/2014 of the European Parliament And Of The Council of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC.
15. ISO 16283-3:2016 Acoustics — Field measurement of sound insulation in buildings and of building elements — Part 3: Façade sound insulation
16. British Standard BS 7445-1:2003 ‘Description and measurement of environmental noise. Guide to quantities and procedures.